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ABSTRACT

This publication for technology teachers is developed around a series of questions commonly raised about the integrated approach to teaching technology. Responses have been provided by eight experienced teachers. An introduction explains the integrated approach and provides a schematic drawing showing the principal phases of the program plus the inputs to each phase. The first series of questions is related to advance preparation. Questions address resource materials, type of classes, getting started, advance preparations, class size, at-risk students, implementation strategies, teaching materials, and costs. Questions on introducing the integrated approach cover the first weeks, student and parent acceptance, and public relations. A series of questions on student research addresses helping students, getting results, writing and checking letters, library research, reluctant students, and integration of math and science. Questions regarding construction activities discuss class control, ensuring student success, time devoted to construction, students who finish early, and students who do not finish. Other questions focus on the seminar (the purpose, preparing students, and the teacher's role) and evaluation of students. The final section answers questions on getting more help, quick start techniques, suggestions for supervisors and administrators, instructional formats, and organization. (YLB)

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Answers

To Questions on Teaching Technology

Revised edition edited by Donald Maley, Ph.D., DTE

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Answers

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Introduction

This publication is for technology teachers and was written by teachers with extensive experience in the teaching of technology. The publication is unusual in its presentation because it was developed around a series of questions that are commonly raised about the integrated approach to teaching technology. The respondents to the questions consisted of eight teachers experienced in the integrated approach to technology education at both the secondary and higher education levels. Each of these teachers has appeared at numerous local, state, and national meetings as interpreters of this approach to teaching technology.

The basic purpose was to develop a publication that would zero in on the problems faced by teachers attempting to implement technology education. It was decided that the most direct procedure would be to provide answers or responses to the most frequently raised questions about implementation.

The questions were identified and were placed under the categories listed in the contents. At least one teacher responded to each question. Some questions had more than one respondent. Such responses are identified as Response A, B, or C. No attempt has been made to modify any of the teachers' answers.

It is important to note that different teachers may have different responses to the same question. This is of special value in providing perspective about alternative approaches. It also is an indication of the freedom permitted teachers to deal with problems as they arise.

The monograph is not a substitute for a good basic course or program designed to prepare the teacher to handle Technology Education through the integrated approach. It is designed for the person who has had good preparation in the program and processes involved but has some additional questions.

Eight practicing teachers contributed to the contents of this publication. Each has had extensive experience with the integrated approach for teaching technology education. These persons were Alan Brown, Karl Gettle, George Haney, Alan Keeny, Lane Knox, Donald Maley, Paul Skellchock, and Donald Smith.

This monograph deals with the processes involved in creating a total education experience. This total education experience will be described under what may be called an "integrated approach" to the study of Technology Education. This integrated approach provides structure and meaning for every part of the student's experience during the term of instruction. The integrated approach deals with such elements or components as problem solving, inquiring, decision making, planning and constructing a project or model, researching, writing a report, reporting to the class, helping others, participating in seminars, and conducting seminars.

The integrated approach is only one of a number of approaches to instructional format and organization in Technology Education. Limiting this monograph to this one approach was done in view of space limitations, plus the overwhelming task of trying to deal with all the strategies associated with this area of study.

Explanation of the Integrated Approach

The integrated approach is a structured form of instruction based on a central theme or major topic. Such topics may deal with the study of technology—past, present and future. Major topics for these three periods might include:

- *Past*—Tools and Machines and their Contribution to Civilization
- *Present*—Technology in Our Community
- *Future*—Energy Sources for the Future

Once the major topic is decided each student selects an appropriate technology related to the major topic. These individual selected topics become subtopics that the individual students agree to pursue and develop as their contribution to the major topic. (This involves the contract method.) Examples of subtopics under the major topic on tools and machines listed above include the cotton gin, windlass, spring pole lathe, Franklin press, potters wheel, and so on. Each student writes a report on his or her contracted item, and constructs a model or mock-up (or an appropriate graphic).

During a total class seminar, students share their reports and projects with the other students. These seminars are chaired by students. It is also a time for questions and discussions about the various technologies presented.

The integrated approach to teaching technology education is

unique in its processes as well as its products. Its uniqueness stems from the fact that—

- It is centered around individual student interests.
- It is group process oriented.
- It is capable of being used with various levels of students.
- Its content can extend across most areas of technology education.
- It utilizes a number of subsystems or strategies such as the individual project, the seminar, group processes, a theme orientation, independent study, problem solving, and inquiry.

Themes or topics in technology education that have proven useful have included:

- The development of tools and machines and their contribution to the growth of civilization
- The development of power and energy and their contribution to the growth of civilization
- The development of communications and transportation and their contribution to the growth of civilization
- Technology in our homes
- Technology in our community
- Technological systems in an airplane
- Technological systems in an automobile
- Technological evolution of our city (state, province, or nation)
- Technological alternatives in energy development
- Technological alternatives in water development
- Technological processes in steelmaking
- Energy sources for the future
- Transportation systems for the future
- Trash and waste disposal alternatives

The general conduct of the unit approach would proceed along the following lines:

- Orientation to the program by the teacher
- Discussion of the program procedures and requirements
- Students select a particular theme or major topic to study
- Students identify potential subtopics under the major topic or theme
- Students select their technology to study
- Students conduct research and inquiry related to their subtopics
- Students produce written reports on their subtopics and construct a project or graphic related to it
- Students conduct class seminars
- Questions related to the use and construction of the technologies are raised and discussed.
- Analysis is made on what has been learned

The figure on the next page is a schematic of the integrated approach showing the principal phases of the program plus the inputs to each.

Photo credits

The photographs show models built by students studying technology. In each case the major topic or theme is followed by a description of the model produced by the student. All the photographs were taken by Charles Beatty, Ph.D., University of Maryland, College Park.

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Energy—Jet engine

Page 9
Water Development—Sea water desalination

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Energy—Model solar home

Page 12
Energy—Early electric motor

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Transportation—Ben Franklin submersible vehicle

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Communications—Franklin press

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Transportation—Monorail systems

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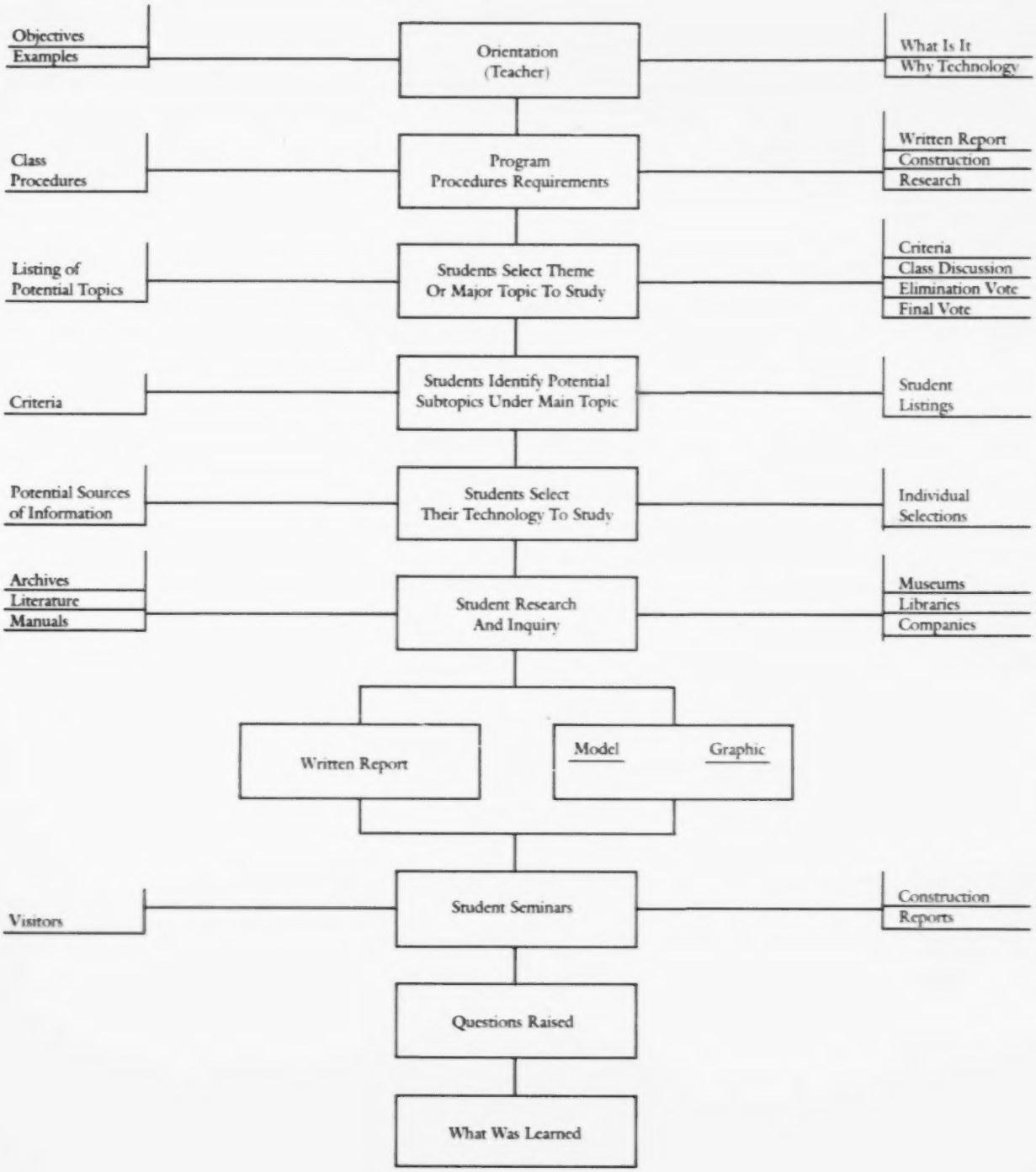
Energy—Nuclear energy

Page 21
Energy—Deep ocean current turbine

Page 22
Early Technology—Sextant

The Integrated Approach To Teaching Technology Education



Advance Preparation

Where can resource materials be found for this program?

- *References:* Books, magazines, and pamphlets on-line data services that cut across the disciplines of history, anthropology, technology, sociology, science, and invention are good resources. These may be found in home libraries, school libraries, area public libraries, and so forth.
- *Displays:* Displays and exhibits like those found in museums, county fairs, and grandparents' attics are helpful resources.
- *Resource People:* Other teachers (history teachers, science teachers, English teachers, etc.), school librarians, area public librarians, museum curators, engineers, and scientists are helpful resources.
- *Industry and Government Agencies:* Pamphlets, booklets, pictures, charts, and so forth dealing with our technological achievements and inventions are resources available (usually free) from large industries and government agencies (General Motors, Bell Telephone, U.S. Department of Transportation, etc.).

What type of class should I have to implement this program?

Response A

Technology education can and has been implemented in all types of classes, from special education to college preparatory classes, and from the most elementary to highly skilled technology education offerings. The reason for this is that the program was developed for all students (boys and girls) regardless of their academic level of performance and background in technology education. However, as in any situation, one will find that the more advanced students will move ahead more rapidly with less direction and guidance from the teacher.

Response B

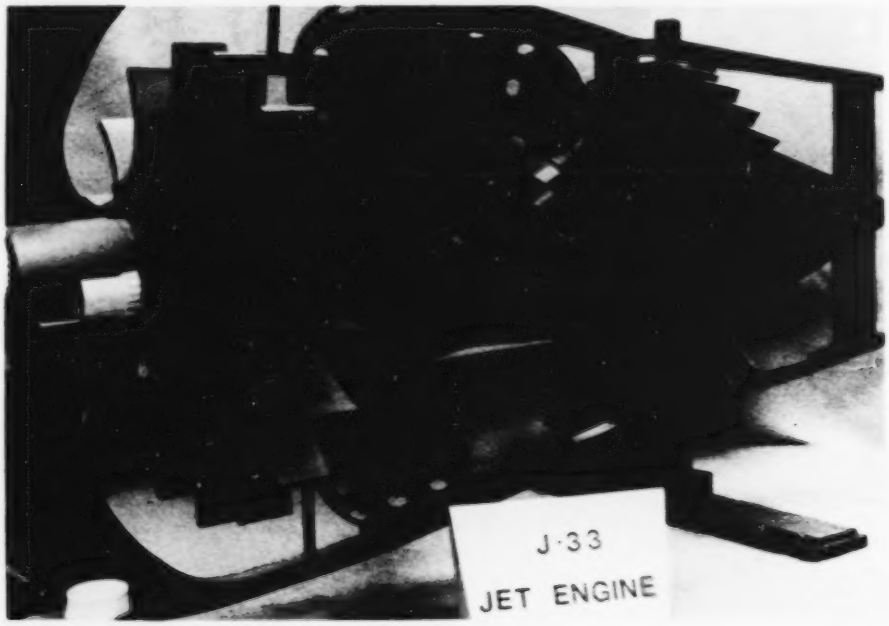
I have taught all ability levels from various socioeconomic backgrounds and have been successful. This approach is a natural starting point for teaching students how humans began to use tools and develop technology.

- The class could be made up of boys and girls who would be taking technology education for the first time. Possibly 6 or 7.
- A teacher starting the integrated method for the first time may want to start with one class until he or she has developed some confidence.

Should the program be started in all classes or just one?

Under ideal conditions, the program could be started in all classes. Unfortunately, conditions are not ideal in many schools; therefore, it is recommended that teachers select one or two classes in which they believe the chances are best for success. This will give the teacher a chance to concentrate on organizing the program and doing the out-of-class planning needed to ensure its success. After the first time through the program, the teacher should feel confident enough to use the program in all classes.

There are at least two important reasons for starting with a limited number of classes. Administrators and supervisors will be eager to support a program that is successful during a trial period. Also, the program may involve using other facilities in



the school, such as the library. It will take some time for you and the librarian to gather materials and develop procedures for large numbers of students to use the facilities.

What advance preparations should be made for the program?

Advance preparation for effective teaching may take one or more of the following directions: preparation at the university or teacher education level; preparation at the school system level; preparation at the local school and community level.

- *Teacher Education Level*

A practicum course conducted at a university or college under the direction of a skilled teacher educator offers the best preparation for receiving the rationale, content, and methodology of the integrated approach. Those who have not had experience with this type of course should consider this avenue of initial preparation. Further information on this approach can be obtained by contacting ITEA.

- *School System Level*

Many local school systems throughout the United States offer workshops or in-service courses on various phases of technology education. Curriculum guides have been developed in school systems based on technology education. Contact your supervisor and indicate your desire to teach technology. Inquire as to the availability of workshops, in-service courses, curriculum guides, and other school system resources.

- *Local School and Community Level*

The advance preparation at the local school level (after receiving adequate knowledge as to the rationale, content, and methodology of the integrated approach) includes the following:

Brief the administration, counseling department, and other members of the technology education department on the nature of the program. Identify the program's educational merits and your desire to implement it.

Brief the school librarian on the nature of the program. Ask for assistance in determining what books and references are available in the library that focus on early technological achievements and inventions in areas of tools and machines, power and energy, and transportation and communications as well as reference materials for the present and future technology studies. Indicate the valuable role the librarian can play in helping your students conduct research activities and locate references they will need during the information-gathering phase of the program. Plan with the librarian a portion of class time (just before the actual research and information-gathering phase) whereby he or she can meet with the class in the library to introduce and review such library procedures as the use of the library indexes (card catalog, readers' guide, etc.), location of books and references, and lending procedures. Request advice and assistance for obtaining additional copies and new books when library funds become available. The availability of computers would be helpful.

Request (if possible) a comprehensive-type laboratory. Or, arrange the assigned facilities (as much as is economically possible) in a comprehensive type of laboratory organization. (Technology studies can be implemented, however, in the unit-type laboratory organization.) A variety of tools and materials to accommodate construction in wood, metal, and so forth should also be asked for if not currently available. The use of computers, robotics, etc., may also be utilized as part of the facility.

Survey the community to determine what resources are available—public libraries, museums, industries, government agencies, and other resource personnel. Develop a brief written summary of the program to be used for public relations purposes; distribute it to parents through PTA meetings and so on.

How long does it take to teach this approach to Technology Education?

Response A

The time will vary in accordance with the level of the students as well as their experience. Some teachers complete two studies in an 18-week period. The first time a study is conducted with a class, it generally takes a bit longer.

The second time may be reduced as much as 2 weeks. Of course, the time in weeks is related to the number of periods per week. As a guideline for classes meeting every day, a first experience for a class may take 10 weeks for one unit study.

Response B

Roughly 8 to 12 weeks. But, this is affected by class size, level of student ability, and the amount of prior instruction in research, planning, and construction activities. Generally, in one 18-week semester where the class meets one period per day, five days per week, two major topics can be studied. The first one will last about 10 weeks (including introduction to the unit, research procedures, sketching and drawing, and construction techniques). The second major topic will last about 8 weeks.

How can I teach this program with a class of 30?

Response A

Teaching this approach to technology is no harder with 30 students than in other methods of teaching. In some ways, you may find technology teaching easier because the role and characteristics of the teacher differ from that which is often found in other programs. If the role of the teacher is understood and practiced, the teacher will have more time to work with students during class.

Response B

Beginning the project work is often difficult for the teacher of a large class. The buddy system can be used if most of the students are ready to begin work on their models at the same time. Two students can work together for two or three days rough cutting the necessary materials from stock. Then, they can continue on their own models or construction on an individual basis. This helps reduce the "waiting-in-line" time for students when they are ready to begin their construction work. This can be a very critical point for the students' interest and enthusiasm if they are ready to begin their construction but must wait in line for two or three days.

Another technique for getting a large class started on the project work is simply to allow students to begin as soon as their planning is approved. This offers an incentive for the students to get their plans completed as quickly as possible, plus it will usually spread the starting times over a period of several days.

How do I handle lower ability or at risk students?

One of the unique values of technology teaching is that it permits students to achieve at their own level. The so-called "lower ability" or the "at risk" student can often provide rewarding surprises when this program is taught. These students should be treated with all the enthusiasm and positive reinforcement at each level of experience given to any other student. Experience seems to indicate that these students seek the level of performance comfortable to them. Usually, they require more time, patience, and guidance to accomplish their tasks. Often their attitude is one of "I can't do it," which is an indication of their negative self-concept. Constant positive reinforcement coupled with an attitude on the part of the teacher that they "can do it" (at their level) will help these students achieve success.

How can I implement this program outside the general laboratory?

Technology Education can easily be carried out in laboratories other than a multi-purpose facility. Teachers have reported successful programs being conducted in metals, woods, graphic arts, electronics, and even drafting room facilities. Other successes have been reported in communications, manufacturing, and transportation facilities. Few, if any, changes are required in most laboratories to implement the program. The students follow the same procedure to fabricate their projects, which now become contracted projects.

Where the facilities of another area are needed, one of two approaches has been used. The first has been to allow students to work in other laboratories as needed. However, when a certain machine or material is used frequently, teachers have taken a second approach and asked for that item to be placed in their laboratory. With careful planning and a little ingenuity (which all technology education teachers possess) this approach can be implemented in your facility.

What materials should be ordered for this program?

So much depends on your individual situation, number of students, and budget that it is hard to be specific when answering this question. I have found that I could run this program on a budget typically used to teach traditional programs. When a student asks,"What material should I use for my model?", I respond, "What material was used to build your project during

that period in history?" The student then can start solving his or her own problem. The question for the teacher still is what materials should be ordered. Most models will use a variety of different materials.

Will this program cost more than my traditional program?

Response A

This is not an easy yes or no proposition. Some traditional programs are quite expensive, while others are relatively inexpensive.

The general feeling among teachers of this approach is that there is little difference in the cost between the two programs. The principal difference in materials is that the technology education topics generally require a greater variety of items. Also, the ability to forecast the materials needed is much more difficult because your students' materials requirements grow out of a wide range of projects to be made.

Response B

Generally, the cost of this program will be about the same as a traditional program.

How does this approach to teaching technology differ from the former industrial arts practices?

Response A

This approach has been in use for 35 years. (It was Technology Education years ahead of its time.) It also involved the integration of mathematics, science and social studies. The major difference is in its holistic approach to education. This is accomplished through a broad interdisciplinary approach as well as a range of inter-related strategies.

Response B

The technology education unit departs from the traditional industrial arts in scope of student activities, focus on technology, and its broad interdisciplinary approach.

Response C

The student is involved in working with the same tools and materials as with the former industrial arts program. However, the technology approach allows the same students to learn more about our society and the role technology plays in it.

Introducing the Integrated Approach

How do I introduce this approach?

The integrated approach centers around the development and contribution of the human's technological achievements—that is, the mastery of raw materials and progress in learning to make tools and machines, harness power and energy, and build communication and transportation devices to improve the way of living. This program of Technology Education can be introduced to students (with the associated research, project planning, and construction activities) in various ways:

- *Films/Videotapes*—Films and videotapes are ways of introducing the nature of technology and this approach. Check with your instructional media specialist for films and tapes on technological developments. Specific types of films or videos include the importance of technological progress and areas of present-day development, important inventions and technological achievements that affected the development of America, and films that are available from the larger industrial companies that focus on early technological achievements and inventions. These help provide the setting to orient students to technology and motivate them to study this important area.
- *Models*— Models and mock-ups are another way of introducing this approach. These provide excellent student motivation and interest because they can quickly "see" *one* kind of "end product" they will have an opportunity to develop. Models can usually be obtained from schools already implementing the approach.
- *Slides*—35mm slides are another option. The slides may be teacher made showing models and displays of inventions found in museums, previous student work at schools already implementing the program, or pictures from books found in the library. Magnetic tapes may be added to provide narration for the slide series.
- *Transparencies and Pictures*—Transparencies describing the nature and activities of technology are yet another way of introducing the program. Books, obtained from the school library and showing pictures with descriptions of inventions, can also be used to generate motivation and student interest. Have students bring to class books, references, pictures, and so on dealing with technology. Use their contributions in a shared exchange of such information. This leads into the next stage of broad unit identification and subtopic selection, followed by drawing activities, subtopic construction activities, and seminar (oral and written) activities.

What instruction precedes the integrated approach?

None is necessary as this may be the initial experience the student has in the laboratory. Exceptions to the above may include the following instruction:

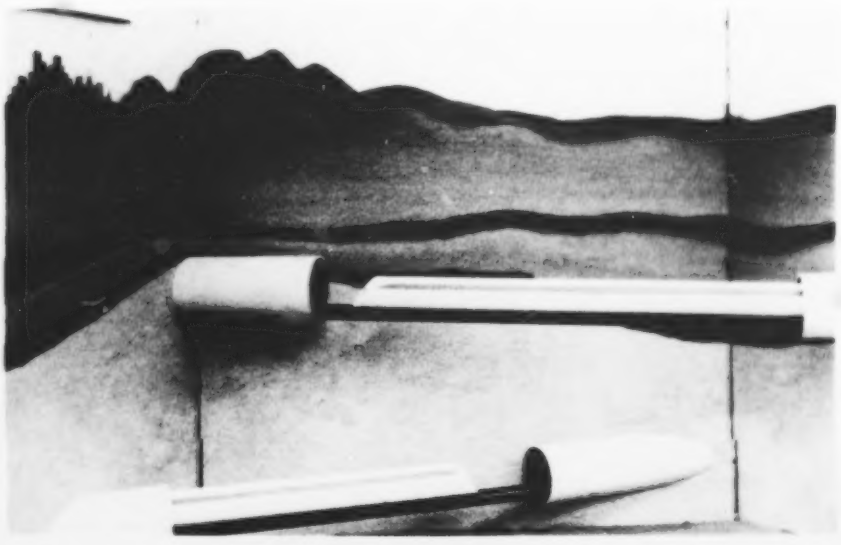
- Indoctrination into and familiarization with the laboratory.
- Presentations by the teacher regarding the proposed program for the term.
- Presentations of vital safety policies, procedures, and requirements.
- Development of basic instruction in drawing to aid in developing plans, sketches, and data collection.

When do you show the students how to use the tools and machines?

Response A

This question requires two different kinds of answers.

- The tools that nearly all students will need to use to get



started should be discussed and demonstrated as early as possible. Tools used in laying out materials are examples in this category.

- Most tools should be discussed or demonstrated as the students have a need to use them or a need to know about them. The instruction in this instance may be on an individual or small group basis. Rarely is the whole class involved in such instruction.

Response B

One effective method of introducing beginning classes to the use of the equipment is to take two days each week during the subtopic planning time to demonstrate and allow the students to work on practice pieces. This method helps break up the planning time with some "hands-on" activities, and it gives the students an idea what tools and machines are available for their use during their planning time. Many times, this will help them with some of their construction details.

The teacher may demonstrate the use of a small number of tools one day and the following day allow the class to practice using these tools. The class can be divided into small groups with a leader selected by each group or by the teacher. The groups can simply move from one operation to another. In a very short time, the entire class will have the opportunity to briefly use all the tools that have been demonstrated by the teacher.

How do I get student acceptance of this new program?

Two key elements in getting students to accept a new program are preparation and enthusiasm. Careful and thorough preparation will help you communicate with the students about this approach. Video presentations, bulletin board displays, and so forth can help you. Be certain when making your initial presentation to show your enthusiasm for the program and the opportunity to work with the students on some interesting technological development.

The most trouble will come from students who have had an experience in some other method of technology education. I have found that after a day or two, when we get "into" our projects, the students forget about what they did before.

I have had almost no trouble interesting students in this approach when this was their first Technology Education experience.

Of course, it must be pointed out that once in a while there is a student who lags behind; but he or she usually takes part in the class after seeing how it operates.

How do I get parents to accept this program?

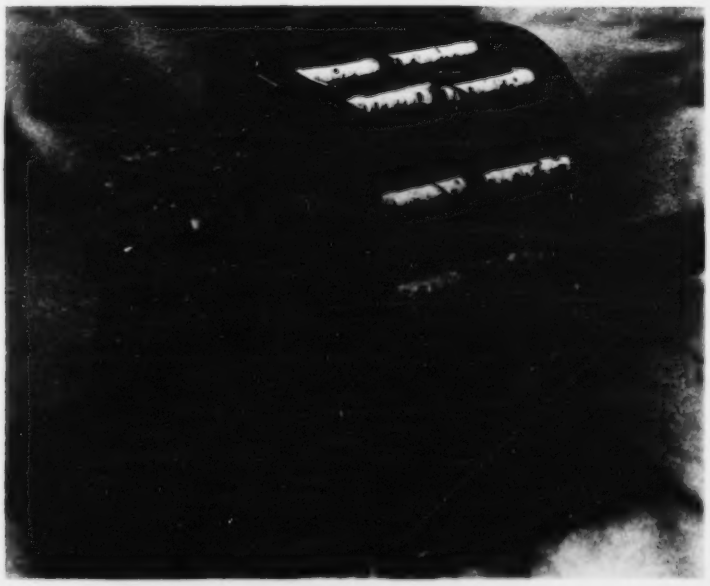
Response A

Parental acceptance of this program will largely be determined by your willingness to meet with administrators, counselors, students, and parents. Parents look to administrators, counselors, and students for reinforcement in making judgments about programs, so your job can be easier if you can gain their support in promoting any new program.

When you have an opportunity to meet with parents, they should first be introduced to the overall role technology education plays in our changing technological society. (Remember, technology education was totally different when they were going to school.) Once you have succeeded in this endeavor, you can confidently move toward an explanation of your teaching strategy.

I have found, in my experiences with parents, that they look most favorably upon this program. They often ask questions concerning a rationale for the course; how it meets the needs of their children; what the behavioral objectives are; what kind of tools, materials, and machines will the students use; what evaluative methods are used; and, as parents, what they can do to help. If you can answer queries like these, you should have no problem getting parents to accept the program.

There are numerous techniques I have used in promoting the program. If it is possible, have examples of students' work (e.g., models, notebooks, drawings, displays) or a videotape of a semi-



nar or a class engaged in construction activities.

Even pictures of various activities (e.g., researching, taking field trips, constructing, reporting, displaying) can reinforce what you are saying about the program. It is most helpful to have this kind of material on hand; but if you are a new teacher and you want to see the program before you actually put it into operation, what can you do? There are several teachers in the area who could possibly lend you examples of their students' work. Or, you might visit their schools to take pictures for your own display.

Also, I have made available take-home material so the parents can study in more detail the objectives of the program. My primary means of communication has been booklets and pamplets.

I have used all these techniques on many occasions and they have been very successful in educating all persons to the benefits of Technology Education.

Response B

- Your most important form of communication with parents is through your students. If you are well organized and enthusiastic in teaching the students, they will undoubtedly enjoy their technology education experience. If the students are able to talk at home about how much they like technology education, there will be very few problems with parent acceptance. In fact, many teachers find that parents offer assistance and resources to the program because their children are enjoying their work.
- Use every opportunity you can get to talk to parents and the community about the program. Back-to-school night, PTA/PTO meetings, open house, and local service organization meetings offer unlimited opportunities to explain the program. Use visual aids and the students' work whenever possible to show what is being done in the program. It is not necessary to compare your program with another. It is usually more effective to give a convincing explanation and description of the program. Remember, parents are most interested in what their children *are* doing rather than what they are *not* doing.

What type of public relations activities will help the technology program be accepted by parents and the school community?

Response A

The actual performance in the program speaks the loudest of all. It is the excitement that the kids take home or communicate in their other school activities that will make a difference.

Response B

Develop a mini-newsletter that goes home with the students. Distribute your newsletter at PTA/PTO meetings. Get local newspaper publicity, and keep your administration informed.

Response C

Take advantage of every opportunity to speak to community groups about your students' work. Invite the local newspapers to attend your classes. Send general information home to the parents on a consistent basis. Invite school administrators, fellow teachers, counselors and school board members to visit.

Response D

Always keep a camera available to capture the work of the students for use in public relations activities.

Student Research

How do I help students do research?

The successful instructor will accept that most students know very little about research techniques. It is your responsibility to teach students how to research a topic of study successfully and thoroughly. Although the following areas of research will be considered on a group basis, most of the research instruction must be on an individual teacher-to-student basis. To aid in this individualized approach, the instructor should request assistance from the librarian, the librarian's aides, students, parents, and any other available personnel.

The following general areas of resources should be introduced to your students:

- Writing letters
- Using the telephone
- Making personal field trips
- Using the libraries (school and public).

It is necessary to provide class time to allow students to follow through on the above four areas of research. Students should be allowed to write letters in class.

Depending on the ability level of the class, you may need to help students construct a model letter. Students should have free access to a telephone during the class session. Personal student field trips may be encouraged to be taken with the family during non-school hours.

Opportunity must be provided to allow the students to use the library within the school. With the aid of the librarian, it is essential that all students be instructed and assisted in the use of the library. They must be taught the various techniques of researching in the library.

Encourage students to find research information and acknowledge their findings.

- Encourage students to assist one another in the quest for information.
- Initiate research competition between classes to encourage a varied approach to seeking information.
- Encourage students to bring their current findings to class each day. The instructor should spend five or ten minutes at the beginning of the period to call attention to successful research and determine possible problems.

How can I help the students get effective results with their letters?

It can be said that a person who receives a letter of inquiry judges its author by the letter's appearance, substance, format, and sincerity. These factors often play an important role in whether or not the letter writer receives a reply. Make it very clear to your students that through the communicative technique of letter writing, they are representing themselves to strangers.

To be sure students are putting their best foot forward, you can do the following:

- See that the student is using school stationery.
- See that the letter is in an accepted business letter format.
- Check the letter for spelling, punctuation, and grammatical mistakes.
- Check the letter for substance.
- Make sure the student is using good penmanship (if handwritten) or is neatly typed (if typewritten), or cleanly printed (if output from a computer).

One other method in getting effective results is to keep a file of sources that have responded to student inquiries. You can reasonably be assured that your current students will also receive a reply.

How do I get students to write letters?

Response A

Students are often reluctant to write letters for numerous reasons. If we can identify these reasons, we can easily dispel the students' fears. Some questions students raise are:

- What are some sources to contact, places to write to?

The teacher can identify a vast number of sources that have been used successfully in the past.

Sources To Explore for a Bibliography

Librarians
Museum curators
Parents, relatives, and neighbors
Teachers
Reference books

Places To Write to

Museums
Government agencies
Historical societies
Park authorities
Private industries

- I don't know how to write a business letter.

You should instruct your students on the accepted format a business letter should take. Also, give them hints as to how to ask for information. For example, ask for not "everything you have"; show you have done previous research, exhibit some knowledge of your subject; and thank them for their help.

- My letter doesn't look good.

Check a student's letter for spelling, punctuation, and grammar. See that he or she has used good penmanship and that the letter is in the correct form. Use school stationery; it makes the letter look good and seems more important to the student.

- My letter doesn't sound good.

You should make constructive suggestions in helping students put their thoughts into words. It is very difficult for many students to compose a letter. This is an area where maximum effort is needed.

In reviewing your students' letter, let them know you are not criticizing them but are trying to help them gain the best results.

As a stimulus, I often show my students a display of letters written and replies received. If they can be convinced that their letters will be answered, the job of writing letters can become an enjoyable, exciting task. And, once free material starts to come in, this "phenomenon" acts as a catalyst and stimulates additional letter writing.

Response B

The idea of receiving something free seems to be a compelling force for humans. If you show samples of free materials you've received through the mail as a result of a letter, it generates the desire for some students to try their luck. As soon as one student receives a response, have that student show and tell. The rest of the students will usually pick up the "free fever," and letters start pouring out from the classroom. It is important to have help available for the students as any reluctance to write at this point is usually a result of a feeling of inadequacy by students. Your students should have the following available:

- Stationery—quality, with the school's heading, so that they can see the letter is considered important. The school's letterhead also helps to get results.
- Envelopes—with return address, again so they know it is important and it is going to be sent.
- A model letter—a reference for them to look at and compare, one that shows form and wording.
- Source of addresses—telephone books, Thomas registry, magazine with advertisements, magazine articles with footnotes, lists of sources developed by students over the years. Suggested sources outside the school (public library, government agencies, etc.) should be in the classroom library for student use.
- Formal instruction on how to write a business letter—How to ask for information and use specific questions (not "Send me

all the information you have"). Letter should show some knowledge of subject in request. This instruction should be given to the student by you, the English teacher, or even the office secretary.

- Teacher availability—you should request all rough drafts be checked so that you can make helpful suggestions without rewriting the letter. If necessary, you should also check the final letter. Be sure to inform students that the checking is to help them get better results.

How can I check to see if my students have written any letters?

The task of finding out if students have written any letters can be done very easily. First, when the students are writing their rough drafts, have them use a return address with the course name and school address. Here is a good example:

Mr. David Meyers
Technology Education Class
Northwestern High School
2727 Fuller Road
Hettick, IL 62649

This return will allow the mail to be routed through you to the student. As you can see, a quick check can be made by using this procedure.

How can I help my students get effective results with library materials?

It is necessary to request as many appropriate books as possible to be purchased by the librarian. This will help students be successful in their quest for information. Ordering books and the search for new sources is an ongoing activity. Schedule the use of the library for a few days well in advance so that the librarian and aides will be available to assist the researching students. This greatly increases the assistance provided each student and ensures effective results.

Invite the librarian and aides to the seminars and laboratory sessions during the school year. This will give them a greater appreciation and knowledge of the approach to teaching technology education. This will indirectly provide the students with more effective results.

Time must be provided for students to use the school library during the school day. Sometimes there is more than one class of students studying technology at the same time. To provide a more extensive use of the available books, it is helpful to alternate the selected major topics of study. For example, it is far better to allow three classes to study either communications and transportation, power and energy, or tools and machines than to allow all three classes to study transportation and communications. The books in the library are limited, and students are usually unsuccessful in their search for information when many classes study one topic.

How long should students spend doing research?

This will vary according to the amount of time being spent on the major topic of study. On the basis of a ten-week unit, the entire class may spent about one week in the library gathering information. The research should be continued on an individual basis until near the end of the class study, with each student checking leads he or she may have gotten in the library, visiting other libraries, writing letters, making phone calls, visiting historical sites and museums, and so on.

In a program of this type, there are many variables that affect the time spent in class on research. A few of these are:

- The amount of material available in the library on a particular subtopic.
- The complexity of the model chosen and the time needed to construct it. (A student with a relatively simple model to build may want to use more time in the library on the written section of the study.)
- The abilities and speed of the student in locating and collecting information.

Any general guide or schedule for the amount of time spent on research must be flexible, both on an individual basis and on a class basis. The nature of the program (student-centered) must allow for student needs, strengths, and weaknesses.

How do I get a reluctant student to select a subtopic?

First, find the reason for the reluctance. Some possible reasons are, the student

- is a poor reader
- thinks it is going to be all book work with no tools and materials
- has not been able to find a source of information on any chosen topic
- did not choose the main topic; wanted a different main topic; wants a subtopic someone else has
- thinks the whole idea is silly; already did this in elementary school.

Assuming the student's reluctance stems from the fact he or she is a poor reader, the teacher should enlist the help of the librarian to determine books that are at a simpler reading level or even picture books. It may require aiding the student with the reading in before- and after-school sessions. If the school has a remedial reading program, help can be obtained by contacting that teacher for suggestions.

If the student believes that the unit activity divides reading and reporting and no constructional activity, show examples of past work and models made in previous classes or borrowed from a neighboring school; show color slides; ask teachers from other schools to let some of their students come in to help motivate; and clear up the idea by letting the student know construction is part of the program—an expected part. Selection of the topic is only the first step.

If the student is unable to find resource materials, many items could be the cause:

- Poor library habits: Review with the student how he or she has approached the problem. If it is misuse of card file, not looking under related headings, not being familiar with periodi-

cal listings, or not being able to find other references from the first reference (using bibliography), the teacher can identify the cause and give concrete instruction. The teacher should be able to give the type of help required or enlist the help of the librarian.

- If it is a difficult topic (some are), your broader experiences should help the student locate one source from which to begin. This means the teacher should develop a file of sources and be familiar with what is in the school library. This will require preparation time on your part. This file can be developed through courses designed to teach this method of teaching. Some of the problems can be avoided if students are allowed to research several topics in the library before they are asked to select a subtopic.

If the student's reason is that the topic selected wasn't the topic he or she wanted to study, he or she probably has a great deal of information on a subtopic in another unit. Naturally he or she prefers that one. This is not an uncommon complaint.

There are several approaches:

- Help students realize they will be gaining by developing a new interest and background in the new topic.
- Be sure that all units will be studied during the year. Thus, the student's special interest will be covered.
- Offer two major topics for study at the same time. The class can be divided into groups of their choice and compete with each other.

The real stickler is when the student wants a subtopic someone else has. You are bound to have at least one of these instances. You could say, "Well, that's life, we don't always get what we want." But that doesn't answer the question. The teacher can assume the role of mediator. Sometimes the student who has the coveted topic is willing to trade or change; sometimes two can work on one topic as long as each contributes to the oral and written reports and each constructs a different model. It is also possible for both to have the same topic but at different periods in history: early invention of crank telephone, operator assisted phone, dial phone. Every effort should be made for students to be happy with their selection. It may be worth considering a period of flux, perhaps three or four days, during which topics can be changed.

The last reason goes back to your introduction: If the student believes he or she has done it all before, that it doesn't make any sense, you must examine your introduction. Review questions in this booklet about selling the idea and introducing technology to the class.

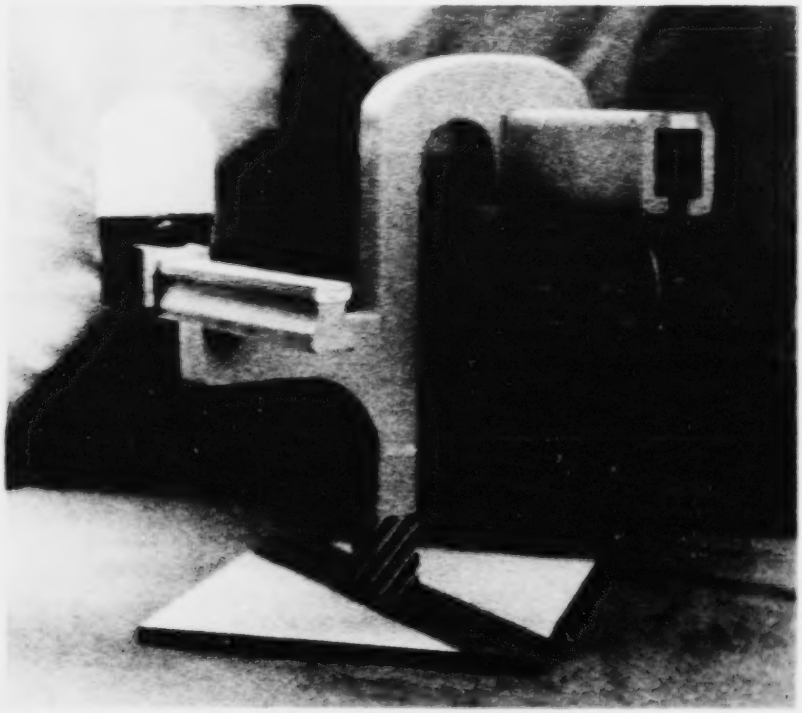
How do I move into a greater integration of mathematics and science?

Response A

This involves a growth process. First, you must see the value in such math and science integration. Second, the teacher with the student must begin to look for the application of science and mathematics in what is done in the laboratory. Finally, your students can seek the help and assistance of their math and science teachers in interpreting what they are doing.

Response B

Don't forget the input from your students. You may find that some of them can be very helpful. Some states (Texas and Maryland) have conducted workshops specifically directed toward the integration of math and science. This involved bringing math, science, and technology teachers together to explore and identify the applications of math and science into the study of technology.



Construction Activities

How do I control the class when everyone is doing something different?

"Control" is usually not a problem in a program of this type. The students nearly always develop a personal interest in their models and are anxious to work on them. However, with all the students working on different projects, there will be many diversified questions and problems. You must not spend too much time with one student while keeping others waiting. If one or two students have particularly difficult problems or need some additional instruction, it would be wise for you to arrange for them to come in during a planning period or after school. This is usually well worth the extra effort for it not only helps the students but it demonstrates to them that you are truly concerned about what they are doing.

How do you help students be successful when they attempt to construct more than they are able to accomplish?

This question is not just limited to the integrated approach.

Any subtopic a student picks can be simplified to meet the student's ability level. A student may decide to build an exhibit instead of a model.

After the students start their project models, you will begin to see the various ability levels in the class and give guidance to those students who are having trouble. Students tend to set their own goals or objectives based on what they feel they can accomplish.

How much time in the total program is concerned with construction activities?

In a ten week program, about six to seven weeks will normally be spent with contruction activities. Time is needed at the beginning of the term for library research and orientation to the lab. The final seminars will take several days at the end of the unit study. Also, a day will normally be taken a few times during the term for progress seminars.

What do you do with the student who finishes the project early?

This is not a problem unique to this method of teaching. Two things must be considered. First, the ability of the student and second, how much time is left before the students leave the course. You might ask the student some of the following questions, depending on the situation and the nature of the model or exhibit:

- Are there any details or other work that you want to add to your project?
- Would you like to add a name plate to your model?
- How about building a stand to hold your model?
- How about mounting your pictures and drawings on poster board and lettering the headings for the class exhibit presentations?

The above questions deal with adding to the original model. It is possible that there would be enough time for a second unit of study. In this case, a student may select a subtopic early and begin research. This time, the student should better know his or her abilities and, with teacher guidance, pick a subtopic of adequate challenge.

If there were only a few days left, the student might like to do something to help the teacher. Such jobs as repairing a broken tool rack or painting a cabinet are always possibilities.

What do you do with students who don't finish the project?

The reason a student did not finish her or his project is one of many concerns related to this question.

A more fundamental concern should center around the educational value of what the student accomplished and might raise the following questions:

- Did the student work up to his or her level of ability and capability in what was accomplished?
- Was the project of such a nature that it would be beyond reason to expect the student to complete it?
- Were there extenuating circumstances that precluded the student's finishing the project?
- Did the student show evidence of substantial growth in the work that was done or accomplished?

If the answers to these questions are affirmative, then the completion of the project might just be incidental to the more important goals of the program. That is to say, the completion of a project may be far down the list of important considerations when judging a student or the value of the experience.

Each case must be treated and handled on the merits of the individual student and the value of the experience to him or her. The overriding consideration should be one of value and contribution to the person. If this consideration warrants a revision upward or downward in the nature, difficulty, or complexity of the project, then this should be a course of action fully understood by both the teacher and the learner.

Some students have been known to complete their project during the summer vacation months or even the following year. This might be something to recommend if all other factors lead to this conclusion.

A far more devastating circumstance might be when students handily finish their project with no challenge or educational gain to them.

Should I produce craftsmanship in the student projects?

Yes. Students should be encouraged to perform at their very best level, regardless of the activity.

The Seminar

How do I introduce the seminar?

The seminar is introduced to the class by explaining just what a seminar is and its intended purpose; that is, how they, as students, will grow educationally by participating in a technology education seminar and of what value is it to them.

The seminar is an educational tool used to bring together individual student abilities and talents to aid in the understanding of one large, comprehensive unit of study.

What is the purpose of a seminar?

- *Presentation*—The seminar, as an educational device, is used to teach youngsters to present information properly in front of a group of their peers and adults. The presentation is geared not only to ***what*** is presented but ***how*** it is presented. Students must be taught how to present properly. It cannot be assumed that some other discipline has taught presentation techniques or that the student already knows these techniques.
- *Interaction*—The seminar is a device that is used to instruct students how to interact with one another in a constructive and positive manner. The seminar, with its physical setting, permits a free flow of educational exchange, which can only be achieved through the seminar.

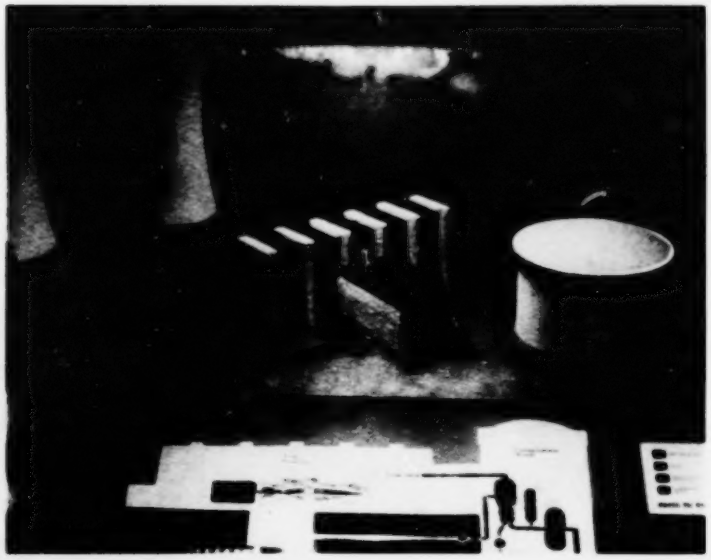
Students must be taught to interact with one another just as they must be taught to present. It should be a period of constructive interaction among all students rather than an unproductive session of negative comments without positive suggestions.

How do I prepare students to present a seminar?

The instructor must first understand that, in general, the students' knowledge of how to present material interestingly and uniquely in front of a group is limited at this level of educational development. Students must be taught how to make an interesting report, just as they must be taught how to solder. It cannot be assumed that they have already acquired this knowledge.

The following areas of instruction should be taught to the youngsters before their seminar presentation.

- *Use of notes*—Require the use of hand-held notes. Notes give presenters a feeling of security and aid them considerably in front of a group. A check of the notes to make certain that they contain key words and phrases and not a written dialogue (students tend to lose eye contact with the audience if notes are written as



sentences) can be a great help to the student. Notes automatically keep the presenters logically oriented and, if written properly, keep them from skipping around or forgetting information completely.

- *Prior preparation*—Encourage presenters to go over their presentation at home or during lab sessions so that they are familiar with the information they will present. This includes the use of visual aids.
- *Visual aids*—Encourage the use of visual aids in the presentations. Demonstrate the use of various visual aids that the students will be using during their presentations. Opaque and overhead projectors are used frequently by students. In most schools, a transparency can be developed rather quickly and economically if the master is developed by the student. The student should make a master using a soft pencil on lined notebook paper making certain that the line work on the master is very dark.

Probably the visual aid that is most frequently overlooked is the model or display that the student has constructed. Much can be explained about the topic by using the authentic model in front of the seminar and pointing out various parts of interest.

- *Delivery technique*—The student must follow an established outline, which can be assured with the aid of note cards. The delivery technique will suffer if the presenter is unfamiliar with the material or the information lacks sequence.

The presenter must practice speaking loudly and clearly to enable all listeners to hear the presentation. During the seminar, a participant's cupped hand to the ear offers a quiet indication to the presenter that he or she is not being heard.

The presenter must be taught to take a minute or two before the presentation to set up those items needed during the presentation. (Students tend to feel that they must begin talking as soon as they reach the front of the room.)

What should the teacher's role be during the seminar presentation?

Response A

During a seminar, your role is usually that of an observer. It is one of the rare occasions when the instructor is free to observe all of the students in a setting much different than that of the laboratory.

Your role is also that of an evaluator. The students are evaluated as presenters, participants, and seminar leaders. It is important that youngsters learn their weaknesses and strengths so that improvements can be made. The successful instructor will involve all students in this evaluation.

During the seminar sessions, it is also your role to make certain that there is a knowledgeable discussion of pertinent information between the presenter and the seminar participants with the opportunity to challenge and question. Your most difficult and important job is to teach students to

- Participate in discussions
- Challenge questionable information
- Offer positive assistance when criticizing or challenging others
- Support and/or document all information offered to the total group

The instructor must also be concerned with the mechanics of establishing a future seminar. You must select approximately four presenters, two back-up presenters, and a seminar chairperson for a future date. However, some instructors prefer to outline the total seminar requirements for the entire semester. Your role would then be simply that of reminding the participants of future seminar dates. The advantage of a semester outline is that it offers the student more preparation time.

Response B

The teacher's role varies with the experience of the student. Initial seminars for most groups involve the teacher to a much greater degree than the seminars held later in the term. Involvement in the early seminars establishes the reasons for and ground rules of effective seminar procedures. This may also involve helping with agendas, room arrangements, instructional devices (projectors, recorders, TV), welcoming guests, establishing procedures, clarifying functions, evaluating, and summarizing.

As the term moves along, your role gradually diminishes to the point where you serve as a consultant, an evaluator, and, in some instances, a summarizer. It is not rare for a good teacher to say nothing or to not overtly direct the class during an entire seminar session. This presents the teacher with an excellent opportunity for observing and evaluating a wide range of behaviors.

Evaluation

How do you evaluate students?

Response A

The uniqueness of the program permits students to be evaluated in many different situations. Specifically, the following instruments can be used to evaluate student behavior.

- Written Progress Reports—reporting progress made in collecting information (listing books, pamphlets, magazines collected; libraries, museums, government agencies, etc. visited; letters written; phone calls made; resource people contacted); reporting progress made with subtopic sketches and drawings; and reporting problems confronted with suggested solutions.
- Oral Progress Reports—brief presentation made before classmates identifying progress as outlined in written progress report.
- Sketches and Working Drawings: drawings of subtopic project evaluated in terms of dimensions, views, neatness, scale, and so on.
- Laboratory Performance—evaluated in terms of consistent work patterns, assistance to others, independent problem solving, correct use of tools and materials, and observation of safety rules and regulations.
- Constructed Project: evaluated in terms of project scale, authenticity, design, workmanship, and so on.
- Written Seminar Report—evaluated in terms of content, organization, neatness, and so on.
- Oral Seminar Presentation—evaluated in terms of organization and delivery techniques, illustrative materials used, and evidence of research techniques used.

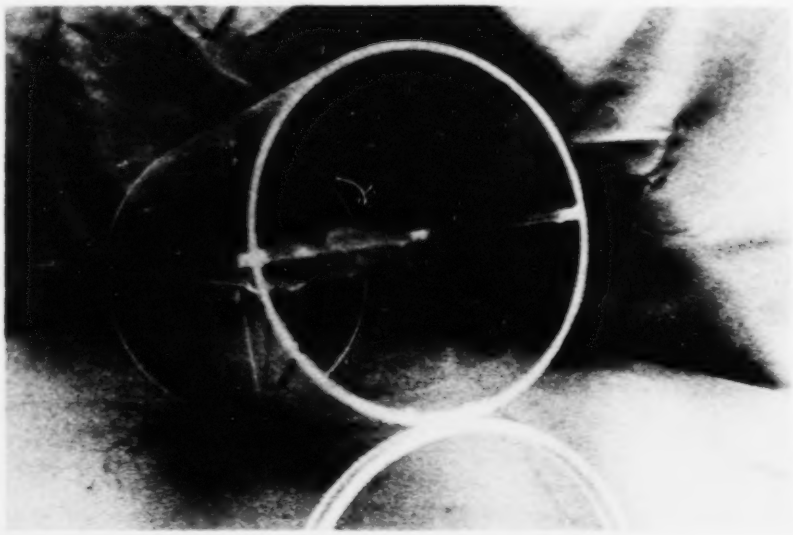
Response B

The evaluation of students should always be in direct relation to the program's goals or objectives for the students. That is, if the program has a goal that deals with the *development of leadership*, the evaluation should then assess the degree and quality of leadership developed by the program.

Evaluation of the integration approach is a much more complex operation, simply because of the wide range of objectives (personal, social, cognitive, affective, motor) dealt with in the program.

The evaluation is largely centered on the personal development of the student with much less emphasis on the traditional craft critique of a project.

Many different forms of evaluation procedures and instruments are available, such as sociometric devices, observation instruments, participation charts, anecdotal records, rating scales, student self-evaluation forms, and teacher-made tests, including true-false, multiple choice, matching, and recall.



Additional Information

Who do I go to for help if I need it?

There are numerous materials available that can be of value to you. The national "clearinghouse" for such reference materials is the International Technology Education Association. By being a member of the Association, you will be kept up to date on the latest happenings. Also, do not forget to request the current publications list. Specific questions should be directed to:

International Technology Education Association
1914 Association Drive
Reston, VA 22091 • 703/860-2100

How can I quickly show the students the characteristics of a new technology program?

It is very easy to show your students the characteristics of the integrated approach through one of the following means:

- Bulletin board displays
- Video presentations
- Overhead transparency presentations
- Relating the experiences and work of other classes
- Field trips to ongoing programs
- 35mm filmstrip presentations
- 16mm movies and videotapes
- Teleconferencing
- Computer networks.

What are some suggestions that may be useful to supervisors and administrators of teachers using this approach?

Response A

Be informed is the first requirement. Keep an open mind to new and innovative practices. Develop a positive approach to problems.

Response B

The administrator or supervisor is really a manager and should do what a good manager does. The manager facilitates—makes things possible, encourages, stimulates, provides guidance and counsel, evaluates, and in general keeps professionally alive.

What are the types of instructional format or organization that are appropriate for Technology Education?

Response A

Successful programs have been carried out using the following forms of educational format or organization.

- The unit method
- The group project
- The research and experimentation format
- The individual project
- The problem approach
- The integrated approach.

Response B

The issue is not just one of format or organizational structure. It is what the teacher (with students) build into the format, i.e. learning to learn, problem solving, communicating, interpersonal relating, decision making, dependability, responsibility, etc.

INTERNATIONAL TECHNOLOGY EDUCATION ASSOCIATION
1914 Association Drive, Reston, VA 22091-1502